Exploranium

DIVISION OF geoMetrics

PORTABLE GAMMA RAY SCINTILLOMETER

MODEL GRS-101A

E104

OPERATING MANUAL

GAMMA RAY SCINTILLOMETER

MODEL GRS-101A

Exploranium
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TABLE OF CONTENTS

Instrument Warranty

Chapter 1.0 GENERAL INFORMATION

1.1 Introduction
1.2 Theory of Operation
1.3 Specifications
1.4 Inventory Inspection
1.5 Instrument Storage

Chapter 2.0 FIELD OPERATION

2.1 Introduction
2.2 New Instrument Checkout
2.3 Battery Voltage Test
2.4 Instrument Operation
2.5 Audio Alarm System
2.6 Low-Temperature Operation
2.7 Possible Survey Difficulties

Chapter 3.0 BATTERY REPLACEMENT

3.1 Battery Types
3.2 Low-Voltage Indicator
3.3 Battery Replacement

Chapter 4.0 SURVEY GUIDELINES

4.1 Introduction
4.2 Test Source

WARRANTY

Exploranium, a division of GeoMetrics, guarantees this instrument to be in perfect operating condition, fully tested, and complete as described for one full year beginning with the date of receipt, but not to exceed fifteen months from the shipping date.

Exploranium and GeoMetrics guarantee that all spectrometers and associated parts offered for sale are free from defects in materials and workmanship, carefully tested, and in first class operating condition. In the event of malfunction, Exploranium, at its own expense, will repair or replace any materials, equipment, work, or parts which prove defective or deficient under normal operating conditions.

Exploranium and GeoMetrics reserve the right to perform warranty services in Toronto, Ontario, or Sunnyvale, California, or at the customer's installation site, whichever is most expedient. Neither Exploranium nor GeoMetrics are responsible for delays or defects in the quality of results from misuse, mishandling, unauthorized modifications, installation or other operation conditions outside factory control.

The above paragraphs apply to all instruments supplied by Exploranium, but exclude photomultiplier tubes, batteries and any damage done thereby, as well as major ancillary equipment in certain systems.

WARRANTY SERVICE

If warranty repair should be necessary, or if technical advice is required, contact either of the following, as most convenient:

Exploranium Corporation of Canada
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Telephone: (416) 661-1966
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1.0 GENERAL INFORMATION

1.1 INTRODUCTION

The Model GRS-101 Total Count Scintillometer is a complete field system designed for man-carry applications requiring accurate and reliable determination of gamma ray intensities from the radioactive elements: Potassium (K^{40}), Uranium (as Bi^{214}), and Thorium (as Tl^{208}). Analysis of gamma ray intensity aids in determining rock types, geologic contacts, radioactive mineral concentrations and additional information useful in mineral exploration. The inherent simplicity of the GRS-101 allows rapid, accurate measurements to be obtained from a compact field instrument. This is a precision instrument, however, and reasonable attention must be given to handling, battery condition and sudden temperature changes.

1.2 THEORY OF OPERATION

The GRS-101 Scintillometer is an instrument that transforms incident gamma ray radiation into a visual readout of radioactive intensity as a function of the natural radioactive material present in geologic phenomena. A sodium iodide crystal converts gamma rays into faint flashes of light whose brilliance is proportional to the energy level of the gamma radiation measured. These light flashes are detected by a high gain photomultiplier tube (PMT), amplified, and fed to circuitry which accepts only those signals above a certain energy. The accepted signals are averaged in a ratemeter circuit as counts per second and continuously displayed on a 250° meter on the instrument front panel. The frequency or signal count rate displayed is the intensity of all gamma ray energy above the preset threshold.

Gamma rays are emitted by certain atoms of elements which are inherently unstable and decay spontaneously with a half life and emitting energy characteristic of all nuclei within that element group. The emission energy is usually expressed in thousands or millions of electron volts (Kev or Mev). The following table describes the unstable elements of interest to radiometric surveys, and the daughter products measured by the GRS-101.

GAMMA RAY ENERGY EMISSION

Parent Atom	Daughter Product	γ Energy Emissions
Potassium 40	Potassium 40	1.46 Mev
Uranium 238	Bismuth 214	.608 - 2.44 Mev
Thorium 232	Thalium 208	.277 - 2.62 Mev

1.3 SPECIFICATIONS

Energy Response:	Total Count (all energies above 0.05 Mev)
Crystal Detector:	1.5" X 1.5" or 38.1mm X 38.1mm ~~1.25" dia. x 1" (31.75 mm x 25.4 mm)~~ standard
Ratemeter Ranges:	100F, 100, 300, 1000, 3000, 10000 C.P.S.
Countrate Display:	250° meter
Time Constant:	Automatically selected with rates for a smooth meter response
Power Requirements:	2 "D" Cells (Battery Life 100 hours continuous with alkaline cells)
Temp. Range:	Limited only by batteries
Audio Alarm	Selectable Trigger points, 25%, 50%, 75% of full scale
Weight:	2.5 lbs 1.1 Kg.
Housing:	Aluminum

1.4 INVENTORY INSPECTION

When received from the manufacturer, the Portable Gamma Ray Spectrometer, Model GRS 101, should include the following items:

1.	GRS101 Console	1 each
2.	Radioactive test source	1 each
3.	Batteries: Type "D" Alkaline	2 each
4.	Operator's Manual	1 each
5.	Wrist Strap	1 each

1.5 INSTRUMENT STORAGE

After use, GRS 101 should be stored such as to prevent damage, loss, or possible contamination through continuous contact with radioactive dust particles.

If the instrument is to be shipped as air or surface freight or long-term storage is anticipated (one month or longer), the batteries should be removed from the console to safeguard against damage from electrolytic leakage or corrosion of battery contacts. Always inspect the batteries, or install new batteries, before using the GRS101 after long storage.

2.0 FIELD OPERATIONS

2.1 INTRODUCTION

The GRS 101 comes complete and ready for field operation. A few simple procedures should be observed to insure optimum results, and it is recommended that the operator follow each step as outlined to become familiar with the various controls, indicators, and survey guidelines.

2.2 NEW INSTRUMENT CHECKOUT

When the instrument is first received from the manufacturer, check the switches for mechanical operation and inspect for damage, examine batteries (separately packed) for any leakage. If the batteries appear in good condition unscrew battery port cap(counter clockwise) install cells positive end in and refit cap securely.

2.3 BATTERY VOLTAGE TEST

Turn the Function switch to the "Batt" position. The audio alarm will sound and the meter will indicate charge condition. This reading must be in the green section of the dial.

2.4 INSTRUMENT OPERATION

When the initial battery check is completed, the GRS-101 is ready for normal field operation. Refer to Chapter 4.0 for general survey guidelines.

1. Turn the Function switch to the ON position or one of the audio threshold positions.

2. Turn the Range switch to an appropriate setting so that the background reading is less than half scale, e.g. set at 100 cps full scale; if reading is over half scale, set to 300 and so on.

2.5 AUDIO ALARM SYSTEM

The GRS-101 is fitted with an audio alarm system which can be set to trigger at 3 selectable levels of full scale of the display meter. These trigger points are selected by the function switch and are labelled in the bracketed section under the Function knob as Audio % F/S (F/S = Full Scale). The three % full scale levels are, and labelled 75%, 50% and 25%. Assume the 50% setting is selected, the audio alarm will sound if the meter reading exceeds 55% of full scale, and stop when the reading drops below 45% of full scale. Similarly for the other two positions, there is a ±5% envelope for the nominal setting. The audio system will not operate when the function switch is set at the ON position and the unit will give only a visual (meter) reading of the response.

2.6 LOW TEMPERATURE OPERATION

At temperatures below 0°C, the effective battery life decreases rapidly from 100 hours continuous at normal average temperatures (with alkaline cells) to only 20 hours at -20°C and 9 hours at -30°C. Lower temperatures do not affect the circuit components, but operation is limited to the effective battery voltage and power available.

2.7 POSSIBLE SURVEY DIFFICULTIES

The following table outlines possible survey difficulties, probable causes and recommended corrective action.

SURVEY DIFFICULTY	PROBABLE CAUSE	CORRECTIVE ACTION
No indication on meter	1. Range switch set too high.	1. Set to lower range.
	2. Poor battery contact.	2. Check for loose batteries and corrosion on contacts.
	3. Dead batteries.	3. Replace batteries and/or observe the battery voltage indicator.
	4. Broken wire(s) internally	4. Re-solder to appropriate point. If uncertain, return instrument to the factory for repair.
Meter reads very high or off scale	1. Range switch set too low for background.	1. Set Range switch higher.
	2. Function switch set at "Batt" position.	2. Set Function to ON or one of the audio trigger levels.

3.0 BATTERY REPLACEMENT

3.1 BATTERY TYPES

The following chart indicates the recommended battery types that are acceptable for use with the GRS-101, and compares the approximate hours of operation possible from each type. The values shown are based upon continuous operation but without the audio alarm on at all. Normally operation is intermittent, minutes to a few hours, and since the audio alarm requires as much current as the electronics, the normal intermittent operation effectively preserves the battery life. The values shown below, however, represent hours of continuous operation. Because the frequency and duration of operating times are so variable, the values shown are approximate only.

BATTERY TYPE	BRAND NAME	CONTINUOUS OPERATION IN APPROXIMATE HOURS			
		25°C	0°C	-20°C	-30°C
Alkaline	Eveready E95 Mallory Mn 1300 Mallory CSR 356	110	70	20	9
Standard Carbon Zinc (Flashlight)	Mallory Burgess Eveready Ray-O-Vac	24	12	0	0
Premium Carbon	1. Burgess 1200* (Super Industrial)	48	24	10	0
	2. Nova Type	50	25	12	

BATTERY PERFORMANCE

*Available from EXPLORANIUM/GEOMETRICS

3.2 LOW-VOLTAGE INDICATOR

The effective operating battery voltage is indicated by a display meter when the "Batt" position is selected on the Function switch. Fully-charged batteries will cause the meter to read full scale. As battery voltage decreases, the meter will indicate less deflection until it leaves the green scale of the dial. At this time the batteries must be replaced as the effective voltage is below that required for operation.

3.3 BATTERY REPLACEMENT

The following steps should be followed for correct replacement of batteries:

1. Unscrew (counter-clockwise) the battery port cap.
2. Tilt instrument to slide out discharged batteries.
3. Install new batteries with positive end in, toward meter

   BOTH BATTERIES SHOULD BE FACING THE SAME DIRECTION.
4. Refit battery port cap and tighten clockwise firmly to effect watertight seal on the "O" ring around the base of the battery port.

4.0 SURVEY GUIDELINES

4.1 INTRODUCTION

Essentially, all soils and rocks emit gamma radiation from three naturally-occurring radioactive elements; potassium 40, bismuth 214, and thallium 208. The gamma ray radiation from these three isotopes are interpreted as being representative of their respective "parent" elements; potassium 40, uranium 238, and thorium 232.

Also counted by the GRS-101 are the cosmic rays which are extra-terrestrial high-energy radiation which contribute usually less than 10% to the measured radiation.

The operator should refrain from carrying radium-dial watches or artificial isotopes and radioactive minerals which will affect the natural radiation environment. If such samples are to be carried during the survey, the operator should step 10 - 15 feet or more away from these items while taking measurements. It is possible that the small test source could affect measurements, and should also be handled in the same manner.

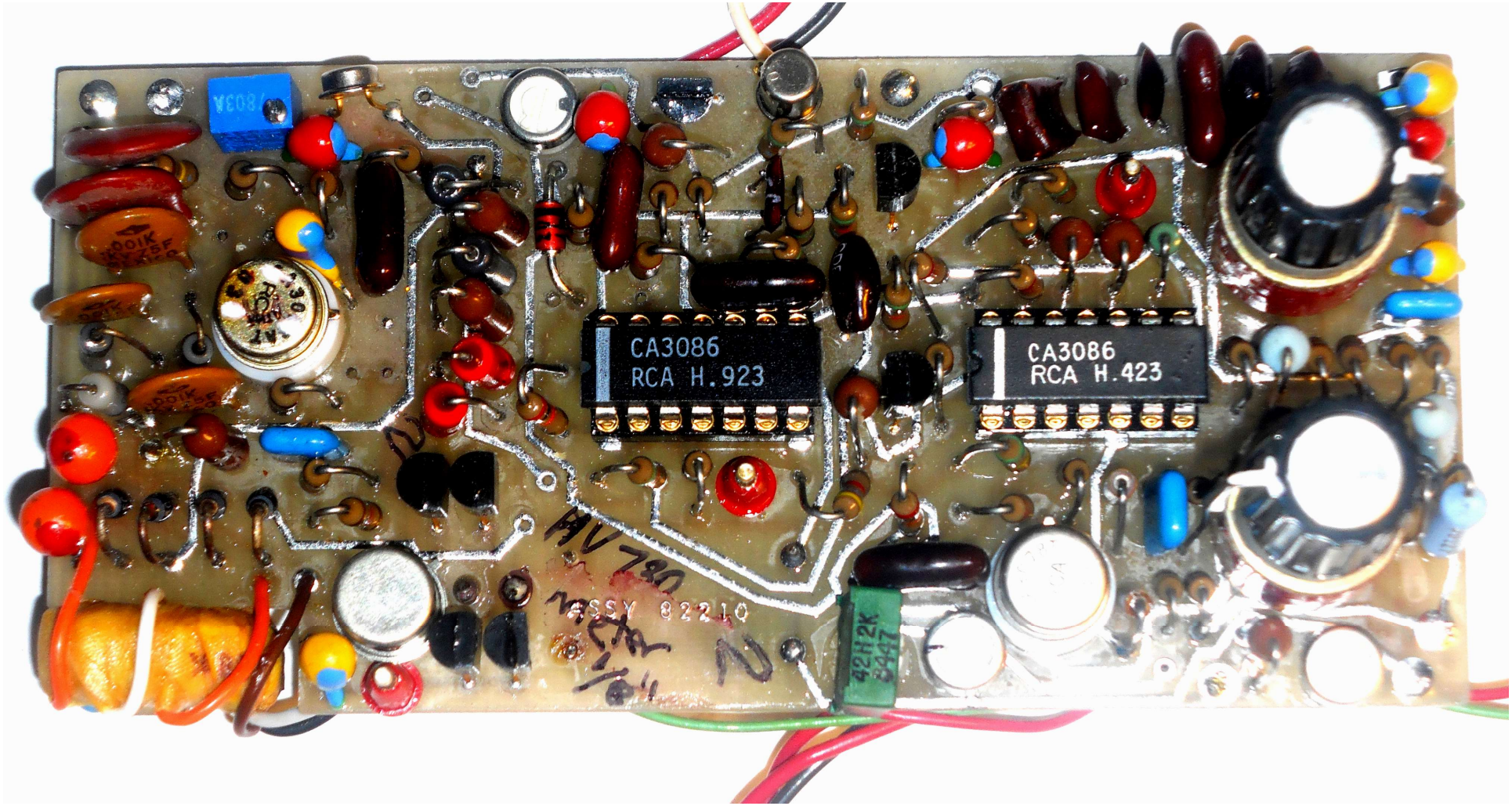
4.2 TEST SOURCE

The radioactive test source is provided simply to check that the unit is operational; it is not a calibration source. The GRS-101 is factory calibrated with a special source and equipment, and should never need any further internal adjustment.

To test instrument operation, hold test source centre at the red area on the case with the RANGE switch set at 3 (300 cps full scale). The meter will indicate within the green band when instrument operation is normal.

4.3 Range Position 1F

The GRS-101 scintillometer has incorporated into the circuitry a faster time constant (position 1F). This range is available for the 100 C.P.S. full scale range only. The range position 1F may be selected in survey areas having a low background reading and where a faster meter pointer movement is preferred.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